UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/772,736	02/05/2004	Juan-Jann Jou	24061.80 (TSMC2003-0343)	5636

42717 7590 09/20/2006

HAYNES AND BOONE, LLP
901 MAIN STREET, SUITE 3100
DALLAS, TX 75202

EXAMINER	
NGUYEN, THANH T	

ART UNIT	PAPER NUMBER
2813	

DATE MAILED: 09/20/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/772,736	JOU ET AL.	
	Examiner	Art Unit	
	Thanh T. Nguyen	2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 May 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *27-51* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *27-51* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

Applicant's arguments with respect to claims 27-51 have been considered but are moot in view of the new ground(s) of rejection.

Specification

The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 27, 33, 36, 40-41, 47, 49 are rejected under 35 U.S.C. 102(b) as being anticipated by Straight et al. (U.S. Patent No. 5,567,650).

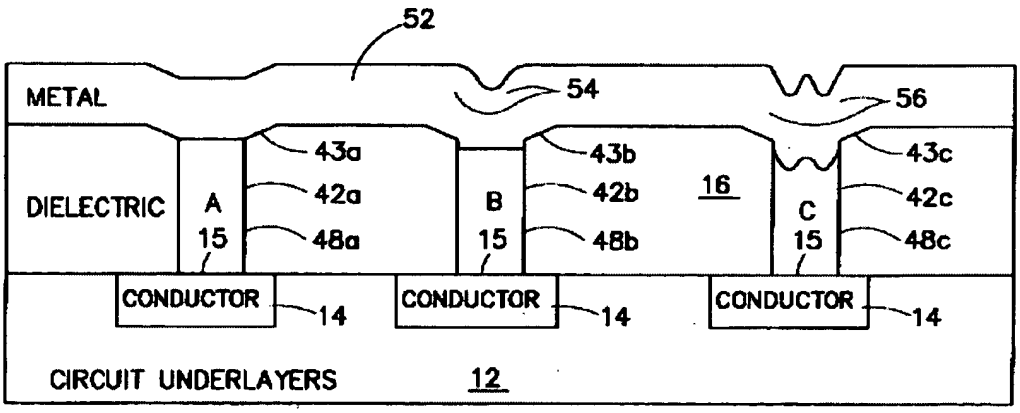
Referring to figures 3-6, Straight et al. teach an interconnect structure, comprising:

a first conductive layer (48c) located in a substrate (12/14, and the bottom part of layer 16);

a dielectric layer (the top part of layer 16) overlying the first conductive layer (48c) and having an opening (40c) extending to the first conductive layer (48c); and

a second conductive layer (52) located in the opening (40c) and contacting a portion of the first conductive layer (48c), wherein an interface between the first and second conductive layers substantially conforms to a substantially curvilinear profile (see figure 6 for detail).

Fig. 6



Regarding to claims 33, 47, wherein the interface profile is substantially W-shaped (see figure 6).

Regarding to claims 36, 49, wherein the interface profile is substantially concave relative to the substrate (see figure 6).

Regarding to claim 40, wherein at least one of the first and second conductive layers comprises one of copper and a copper alloy (see col. 3, lines 21-24).

Regarding to claim 41, an integrated circuit device, comprising:

a plurality of semiconductor devices coupled to a substrate (see figures 3-6, and col. 1, lines 7-10); and

an interconnect structure (48/52) coupling ones of the plurality of semiconductor devices, the interconnect structure (see figures 3-6) including:

a plurality of first conductive layers (48c);

a dielectric layer (the top part of layer 16) overlying ones of the plurality of first conductive layers (48c) and having a plurality of openings (40c) each extending to one of the plurality of first conductive layers (see figures 3-6); and

a plurality of second conductive layers (52) located in ones of the plurality of openings (40c) and each contacting a portion of one of the plurality of first conductive layers (48c), wherein each interface between corresponding ones of the first and second conductive layers substantially conforms to a substantially curvilinear profile (see figure 6).

Claims 27, 31-32, 36, 39-41, 45, 46, 49 are rejected under 35 U.S.C. 102(e) as being anticipated by Barth et al. (U.S. Patent No. 6,613,664).

Referring to figures 4-5, 8, Barth et al. teach an interconnect structure, comprising:

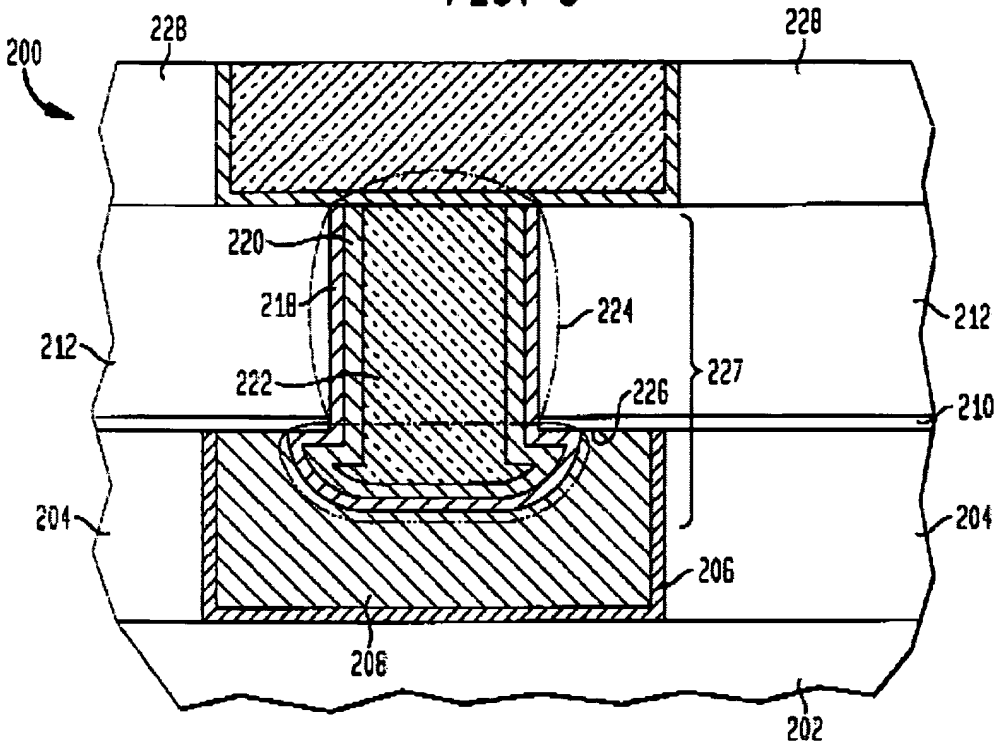
a first conductive layer (208) located in a substrate (202/204);

a dielectric layer (210/212) overlying the first conductive layer (208) and having an opening (213) extending to the first conductive layer (208); and

a second conductive layer (218/220/222) located in the opening (213) and contacting a portion of the first conductive layer (208), wherein an interface between the first and second

conductive layers substantially conforms to a substantially curvilinear profile (see figure 5 for detail).

FIG. 5



Regarding to claim 31, 45, diffusion barrier layer (218) interposing the dielectric layer and the second conductive layer (see figure 5).

Regarding to claim 32, 46, diffusion barrier layer (218) interposing the first and second conductive layer and substantially conforming to the interface profile (see figure 5).

Regarding to claims 36, 49, wherein the interface profile is substantially concave relative to the substrate (see figure 5).

Regarding to claim 39, wherein the opening is one of a via hole opening and a dual damascene opening (see figure 8).

Regarding to claim 40, wherein at least one of the first and second conductive layers comprises one of copper and a copper alloy (see col. 5, lines 47-50, col. 6, lines 43-45).

Regarding to claim 41, an integrated circuit device, comprising:

a plurality of semiconductor devices coupled to a substrate (see figures 3-6, and col. 5, lines 27-30); and

an interconnect structure (208/222) coupling ones of the plurality of semiconductor devices, the interconnect structure (see figures 5) including:

a plurality of first conductive layers (208);

a dielectric layer (210/212) overlying ones of the plurality of first conductive layers (208) and having a plurality of openings (213) each extending to one of the plurality of first conductive layers (see figures 5/8); and

a plurality of second conductive layers (222) located in ones of the plurality of openings (213) and each contacting a portion of one of the plurality of first conductive layers (208), wherein each interface between corresponding ones of the first and second conductive layers substantially conforms to a substantially curvilinear profile (see figure 5/8).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 33, 38, 47, 51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barth et al. (U.S. Patent No. 6,613,664) as applied to claims 27, 31-32, 36, 39-41, 45, 46, 49 above in view of Straight et al. (U.S. Patent No. 5,567,650).

Barth et al. teaches an interconnection structure above. However, the reference does not teach the interface of the profile is a substantially W-shaped, or substantially trapezoidal, peaked profile.

Straight et al. teaches forming an interconnect structure wherein the interface profile is substantially W-shaped (see figure 6).

Therefore, it would have been obvious to one of ordinary skill in the art to form the W-shaped trench in process of Barth et al. as taught by Straight et al. because it would form a desired shape of interconnect structure. It is well settled that, the change in shape of the trench (i.e. W-shaped, or substantially trapezoidal, peaked profile) was a matter of design choice which a person of ordinary skill in the art would have found obvious absent persuasive evidence that the particular configuration of the trench was significant. *In re Dailey*, 357 F.2d 669, 149 USPTO 47 (CCPA 1996).

Claims 28-30, 34-35, 42-44, 48, 50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barth et al. (U.S. Patent No. 6,613,664) as applied to claims 27, 31-32, 36, 39-41, 45, 46, 49 above in view of ordinary skill in the art.

Barth et al. teaches an interconnection structure above. However, the reference does not teach the specific depth/height range of the profile of claims 28-30, 34-35, 42-44, 48, and 50.

The specific range of depth/height of the profile in claims 28-30, 34-35, 42-44, 48, and 50 are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted in In re Aller, the selection of reaction parameters such as temperature and concentration would have been obvious:

> "Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may impart patentability to a process if the particular ranges claimed produce a new and unexpected result which is different in kind and not merely degree from the results of the prior art...such ranges are termed critical ranges and the applicant has the burden of proving such criticality.... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."
> *In re Aller 105 USPQ233, 255 (CCPA 1955). See also In re Waite 77 USPQ 586 (CCPA 1948); In re Scherl 70 USPQ 204 (CCPA 1946); In re Irmscher 66 USPQ 314 (CCPA 1945); In re Norman 66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).*

Therefore, one of ordinary skill in the requisite art at the time the invention was made would have used any range suitable to the device of an interconnect structure of Barth et al. in order to optimize the process and produce the interconnect structure desired to the parameters desired..

It would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made to optimize the profile height/depth range, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. In re Aller, 105 USPQ 233 (CCPA 1955).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Nguyen whose telephone number is (571) 272-1695, or by Email via address Thanh.Nguyen@uspto.gov. The examiner can normally be reached on Monday-Thursday from 6:00AM to 3:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, can be reached on (571) 272-1702. The fax phone number for this Group is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956 (**See MPEP 203.08**).

Thanh Nguyen
Patent Examiner
Patent Examining Group 2800

TTN